



Human Effectiveness Directorate

USAF Scientific Advisory Board 1999 S&T Program Review Training for Warfighting Thrust

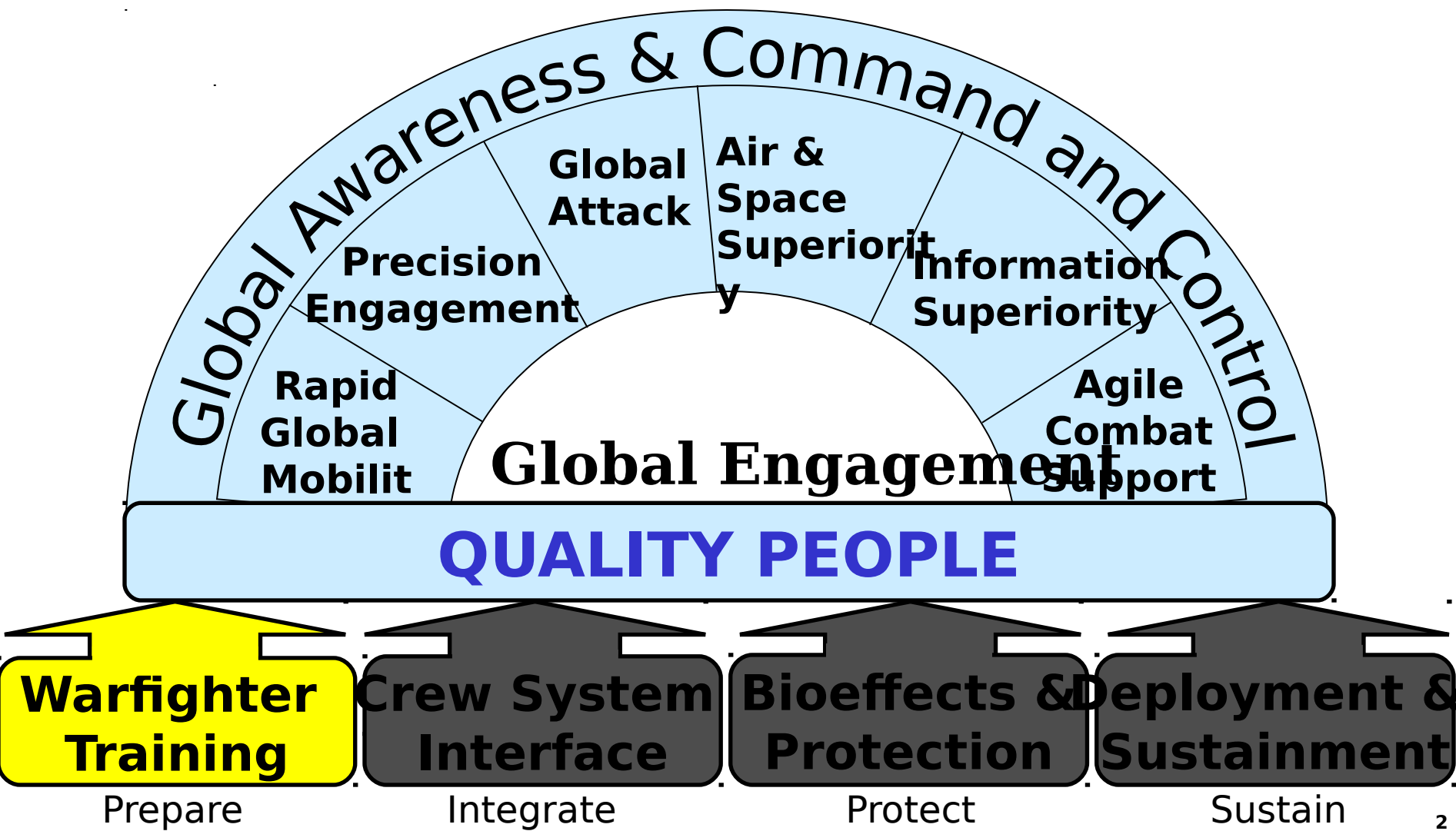


**Air Force
Research Laboratory | AFRL**
Science and Technology for Tomorrow's Aerospace Force

**Col Jerry Straw
Warfighter Training Research
Division**



Technology Thrusts A Foundation for Global Engagement





Outline

- **Challenges**
- **Vision/Mission/Goals/Objectives**
- **Assets**
- **Strategy**
- **Accomplishments**
- **Recognition**
- **Future Opportunities**
- **Briefing/Poster Selection**
- **Summary**
- **Program Briefings**



The Challenge

- **Meet Warfighter Readiness Training Requirements**
- **Support Expeditionary Aerospace Force Concept**



**Global Battle Space Information
Sphere**



Readiness Training Constraints

Constantly growing...



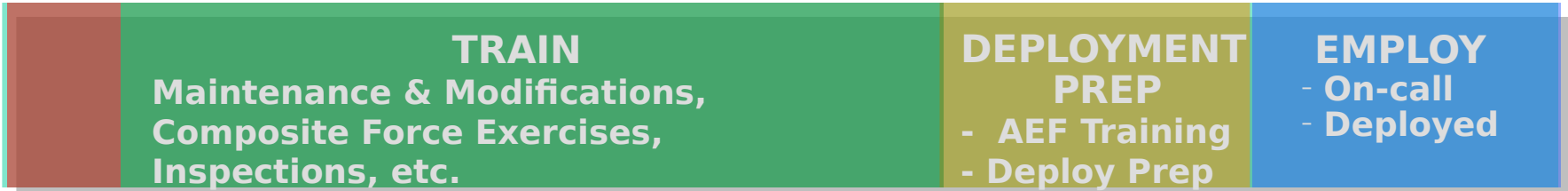
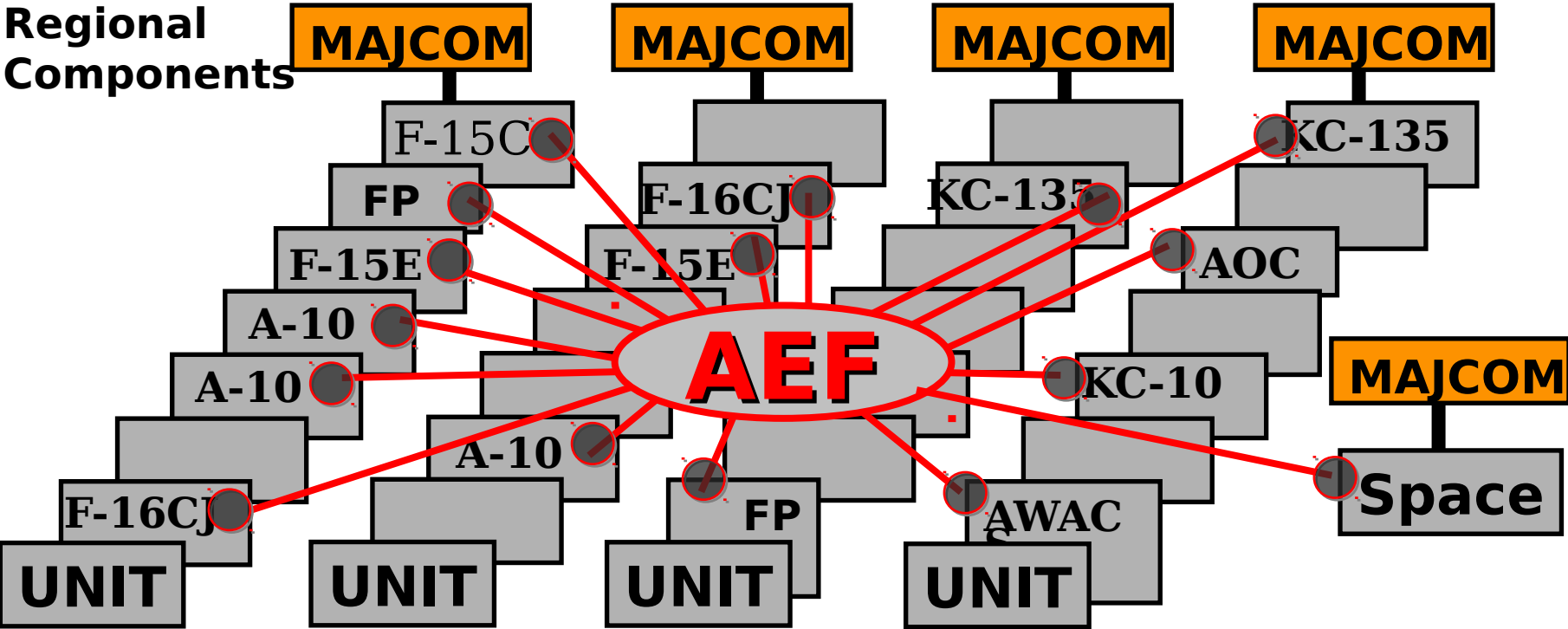
- ***Resources and funding... ranges, flying, time, etc.***
- ***Equipment and personnel... airframe wear, opstempo, deployments, etc.***
- ***Safety and security... live weapons employment, classified systems, etc.***

... modern weapons and employment concepts require extensive airspace, large ranges, and more composite training opportunities



Aerospace Expeditionary Force Training Challenge

Regional Components



Distributed Mission Training Research and Development Program

Expeditionary Air Force Enabler



Vision

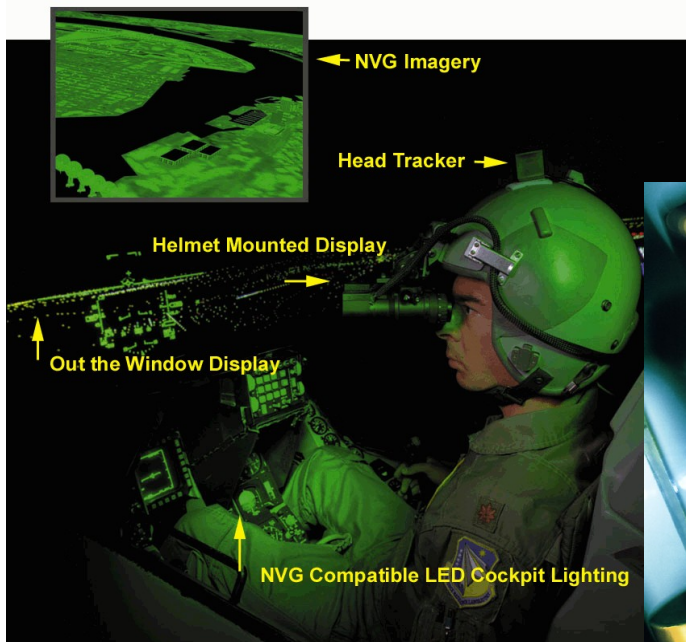
Provide world's best training, ensuring warfighters have the skills to win





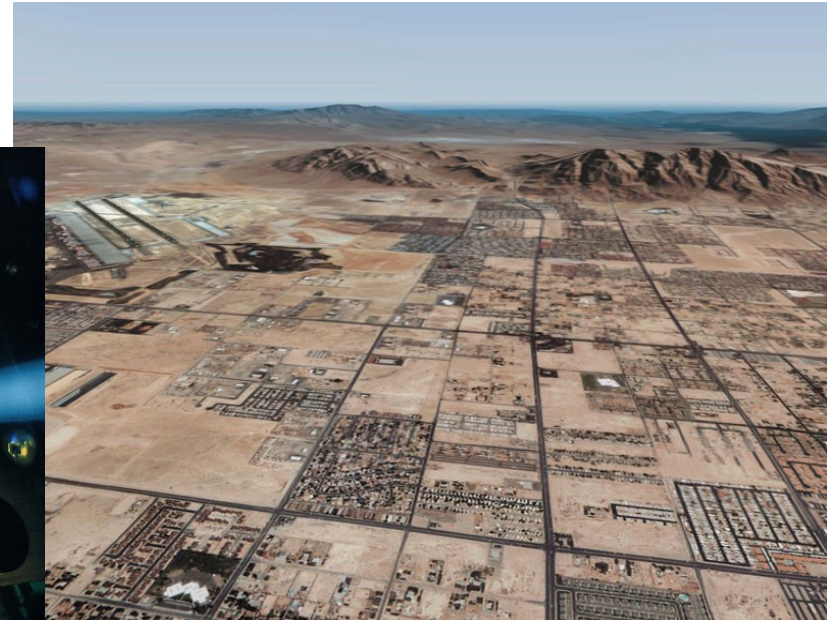
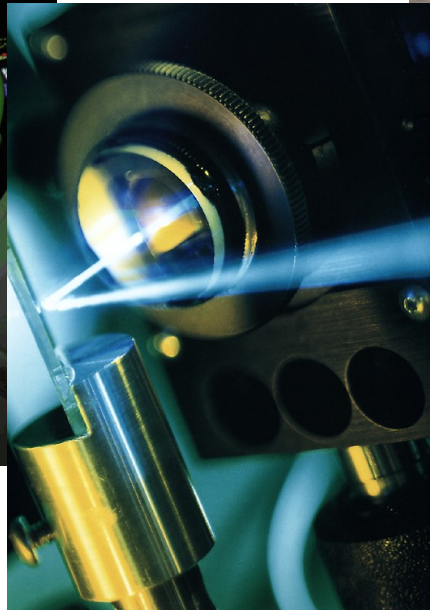
Mission

Research, develop, demonstrate, evaluate and transition leading edge technologies and methods to train warfighters



Night Vision Training Systems

Microlaser Projection Systems



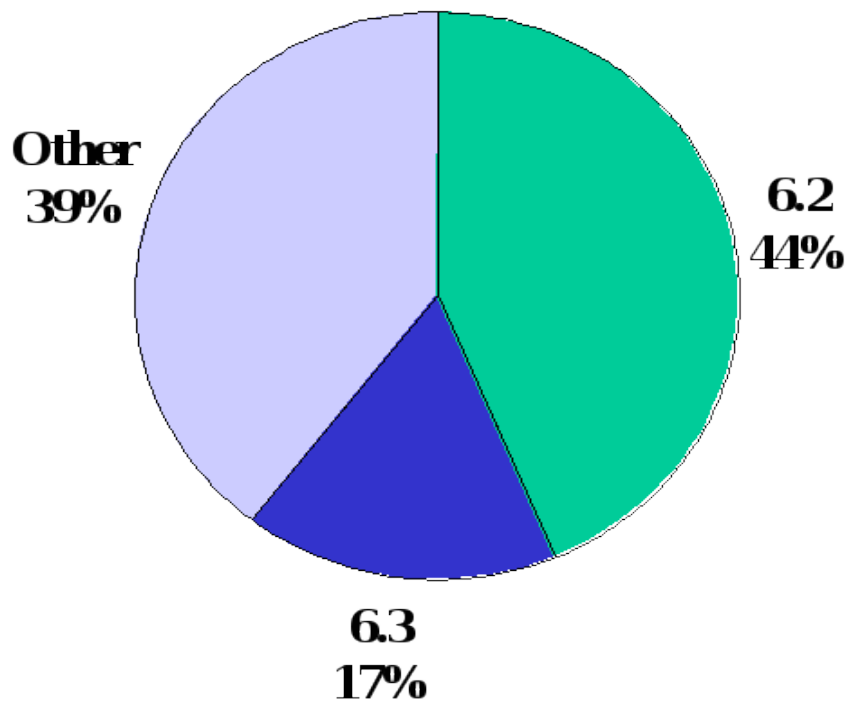
High Resolution Photo-realistic Database

Peter Drucker: “The best way to predict the future is to create it”

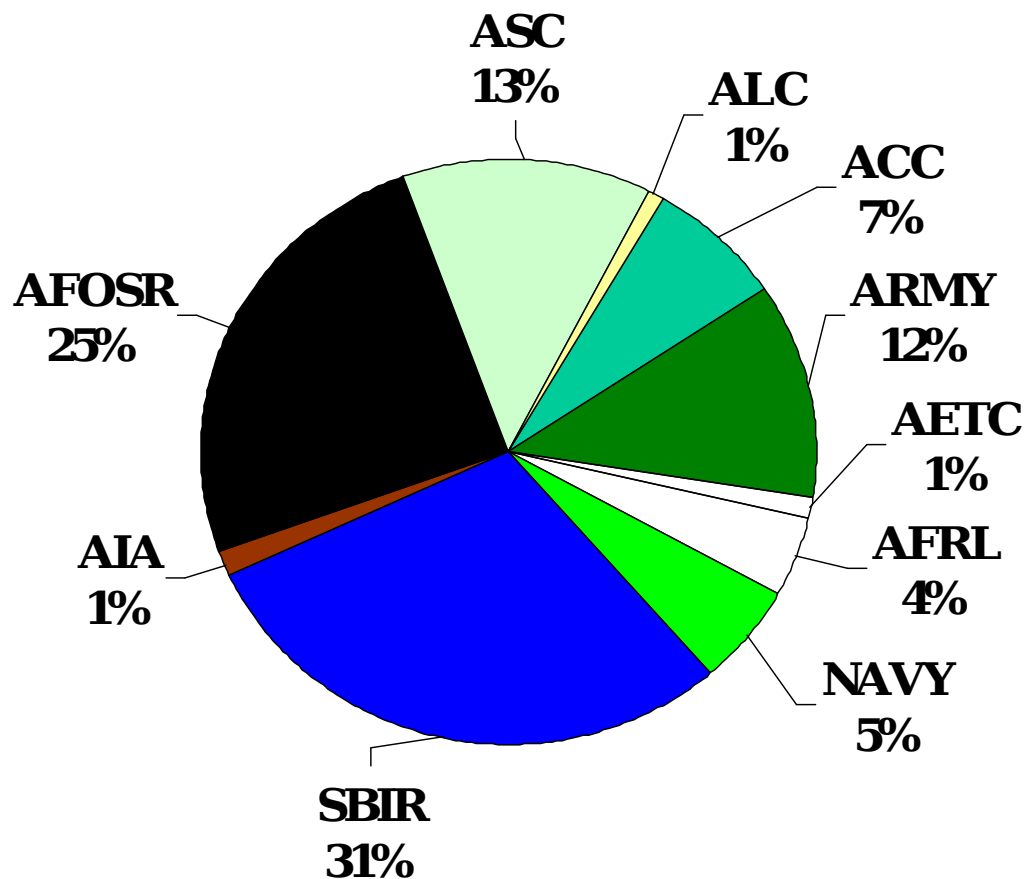


FY99 Funding

\$38,989,000
(Unburdened)

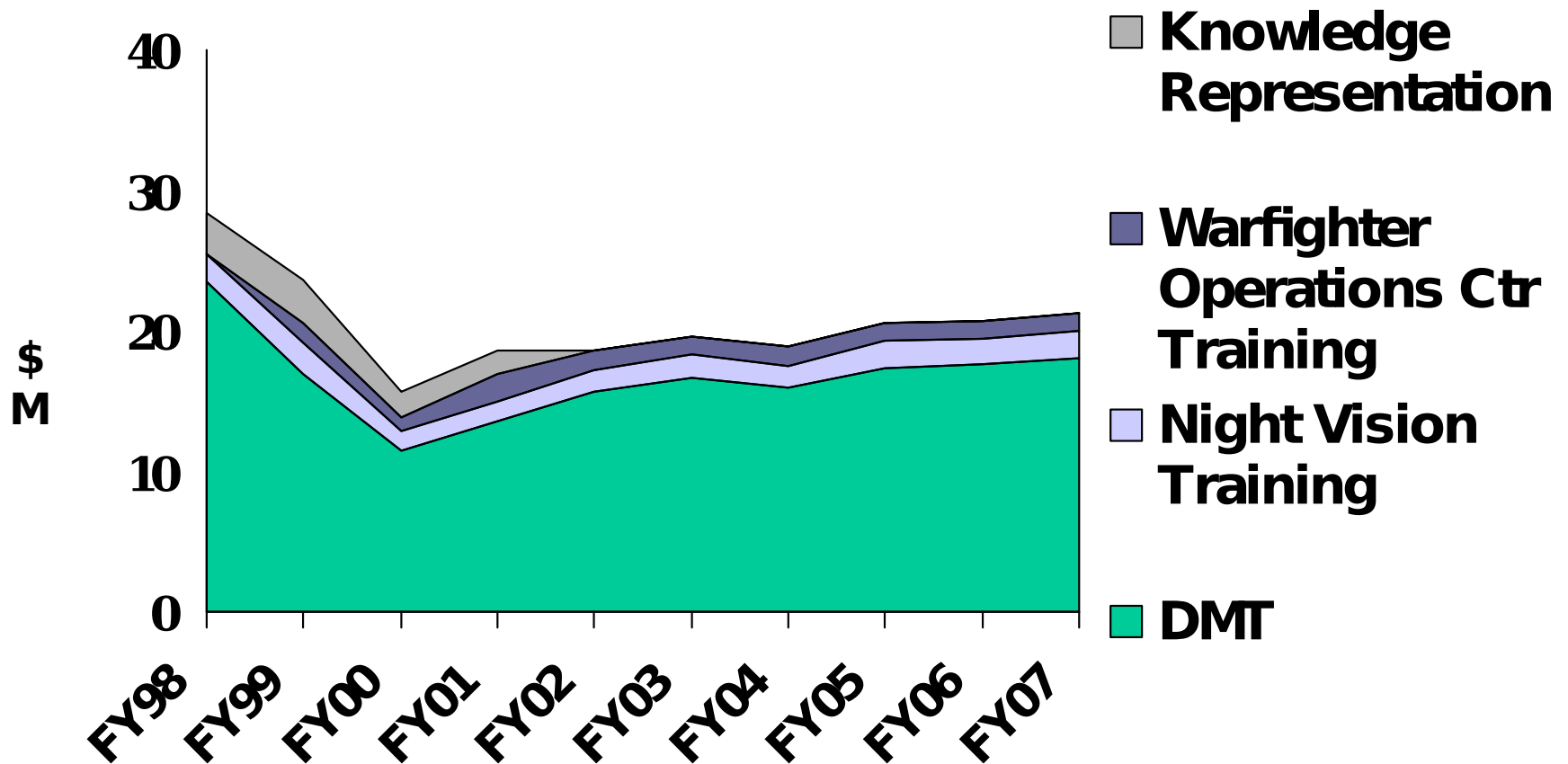


Other Funding





Warfighter Training Thrust





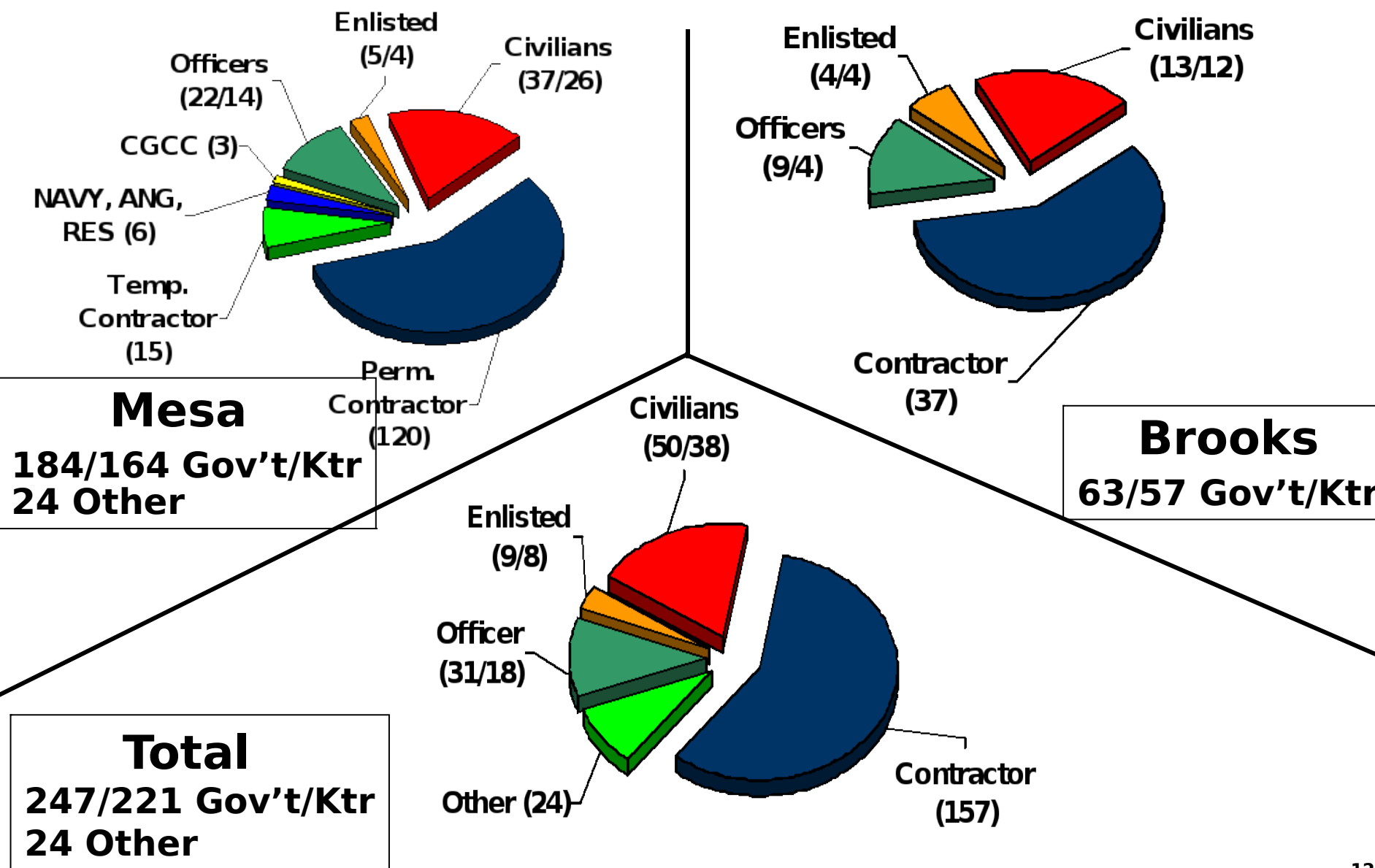
Return On Investment

AF SPENDS HEAVILY ON TRAINING

- **Cost to Produce an Experienced Pilot (9 Yrs)**
 - **F-15C \$8M**
 - **F-16C \$4M**
 - **B-52H \$9.1M**
 - **C-141B \$3.1M**
- **≈ \$7B/yr Continuation Training**
 - **12,600 Pilots (9,000 Flying)**
 - **≈ 200 sorties / yr**
 - **≈ \$4K / sortie**
- **Current ≈ \$20M / yr DMT-A R&D Investment (Less Than .0025 of AF Training Investment) Can Conservatively Generate 10% Savings = \$700M / yr**



Warfighter Training Research Facility Workforce





Top Performer Recognition

- **Dr. Winston Bennett**
 - 1999 APA Early Career Award
 - 1999 AFRL Harry G. Armstrong Scientific Excellence Award
- **Dr. Kurt Steuck**
 - 1999 VP Gore Hammer Award for Re-inventing Government
- **Dr. Dee Andrews**
 - 1999 Elected to Fellow in the U.K.'s Royal Aeronautical Society
 - 1998 Elected to Fellow in the Human Factors and Erg. Society
- **Drs. Crane, Sorensen & Bell**
 - 1997 Federal Lab Consortium Award for Excelling in Tech Transfer
- **Dr. Bob Nullmeyer**
 - 1997 Best Paper Award, Interservice/Industry Training Systems and Education Conference

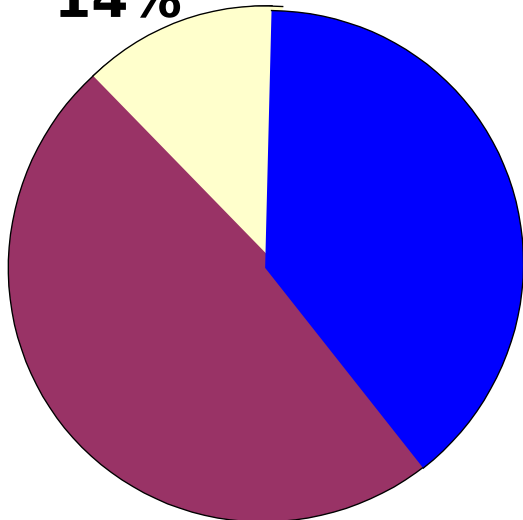


HEA S&E Education Levels Brooks/Mesa

Government Personnel

43 S&Es

**MA/MS
14%**

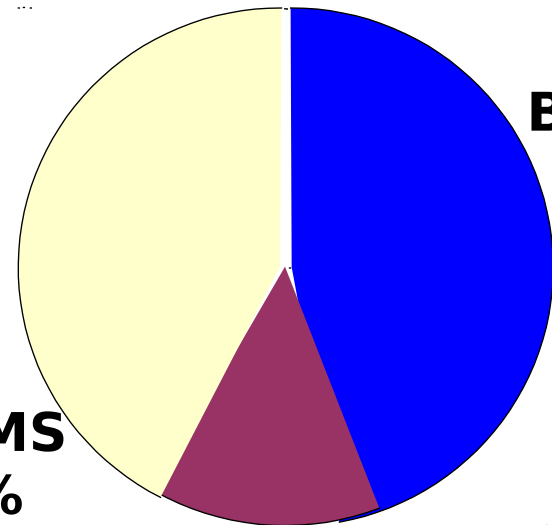


**BA/BS
39%**

**PhD
47%**

On-site Contract Personnel **95 S&Es**

**MA/MS
39%**



**BA/BS
45%**

**PhD
16%**



Government Disciplines

- **Instructional Psychology**
- **Physics**
- **Optics**
- **Electronic Engineering**
- **Mechanical Engineering**
- **Physiology**
- **Aviators**
- **Operations Research**
- **Security Specialist**
- **Industrial/Organizational Psychology**
- **Experimental Psychology**
- **Cognitive Psychology**
- **Flight Surgeon**
- **Aeronautical Engineering**
- **Computer Science**



Additional On-site Contractor Disciplines and Capabilities

- **Simulation Networking**
- **Statistical Analysis**
- **Biomechanical Engineering**
- **Ergonomics**
- **Operations Research**
- **Aerospace Medicine**
- **Multimedia Graphic Design**
- **Constructive Modeling**
- **Simulation Fabrication Specialists**
- **Image Generation Engineering**
- **Visual Display Engineering**
- **Educational Psychology**
- **Modeling and Simulation**
- **Instrumentation**
- **Human Vision**
- **Systems Engineering**
- **Mathematics**
- **Internet/Intranet Web Design**



Mesa



10
Buildings
97,916 GSF
6.542 acres

Main Buildings

Bldg 558 - 28,541 gsf -
Development

Bldg 560 - 9,600 gsf-

Bldg 561 - 30,666 gsf-

Bldg 562 - 4,400 gsf -

Bldg 570 - 17,283 gsf -

Building Function

NVD, A-10/F-16

Contractor Office/Admin

DMT Testbed & Gov't Office

Raytheon Offices

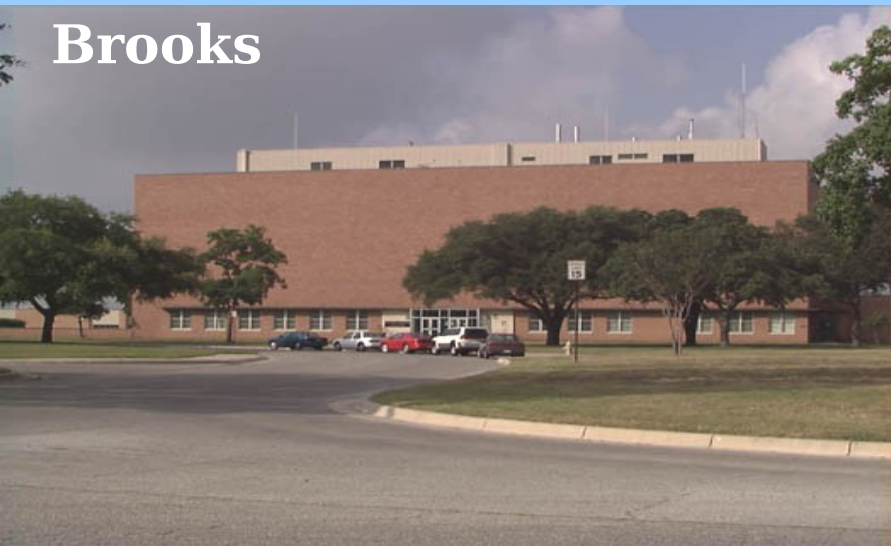
NVG, CGCC, Visual Lab,

Fabrication Shop



Brooks/Lackland AFB Facilities

Brooks



Main Buildings (Brooks)

Bldg 125 - 11,130 gsf

Bldg 130 - 2,440 gsf

Bldg 170 - 8,000 gsf

Lackland

Bldg B9020 - 25,000gsf

Lackland



Building Function

Combined Lab/Admin Space
AVATAR

Administrative Space

Combined Lab/Admin Space
C3STARS & Virtual Lab

Building Function

Combined Lab/Admin Space
8 testing bays/250 comp



Facility Use

By Outside Organizations-FY99

AGENCY	FUNDING	FACILITY	%USE
XO	\$ 30,000	DMT TESTBED	4%
ACC	\$ 187,169	DMT TESTBED	4%
DMSO	\$ 82,700	DMT TESTBED	6%
J SF	\$ 640,000	DMT TESTBED	8%
AFRL	\$ 967,263	DMT TESTBED	6%
ACADEMIA(ASU)	\$ -	DMT TESTBED	6%
INDUSTRY	\$ 300,000	DMT TESTBED	6%
ACC	\$ 993,000	PREDATOR TESTBED	50%
ASC	\$ 1,251,356	NVG	5%
USNAVY	\$ 1,174,330	NVG	20%
AFRC	\$ 2,835,000	A-10 TESTBED/CMS	66%
SM-ALC	\$ 1,440,344	A-10 TESTBED	33%
ANG	\$ 22,800	A-10 TESTBED	1%
AETC	\$ 3,125,100	CRM	0%
ESC	\$ 250,000	CLT SOFTWARE	0%
OO-ALC	\$ 120,000	B52 WST SOFTWARE	0%
USARMY	\$ 1,735,000	TRAINING SOFTWARE	0%
TOTAL	\$ 15,154,062		
		TOTAL EXTERNAL USE	40%



Core Competencies

- **Theory and Science of Learning and Instruction**
- **Methods for Development and Evaluation of Warfighter Training**
- **Tools and Technologies for Training for Warfighting**



Strategy

- **Collaboratory**
- **Testbed**
- **Partnerships**



Collaboratory

- **Government, academia and industry partnership**
 - **Leveraging partner's funding and capabilities**
- **Industry and academia view lab as a shared testbed enabling them to try new technologies and methods**
- **Industry brings equipment, expertise and funding**
- **Protection of proprietary and intellectual information and technology is key**
 - **Non-disclosure agreements, and on special occasions "rope off" part of the testbed**



Sample of Collaboratory Partners (Total 25)

- **Raytheon, Boeing, Lockheed-Martin**
- **Evans and Sutherland**
- **Silicon Graphics**
- **MultiGen/Paradigm**
- **Motorola**
- **Aechelon**
- **Arizona State University**
- **SAIC**
- **Original Sim**
- **GTE**
- **Advanced Training Systems Inc.**
- **CEOS**

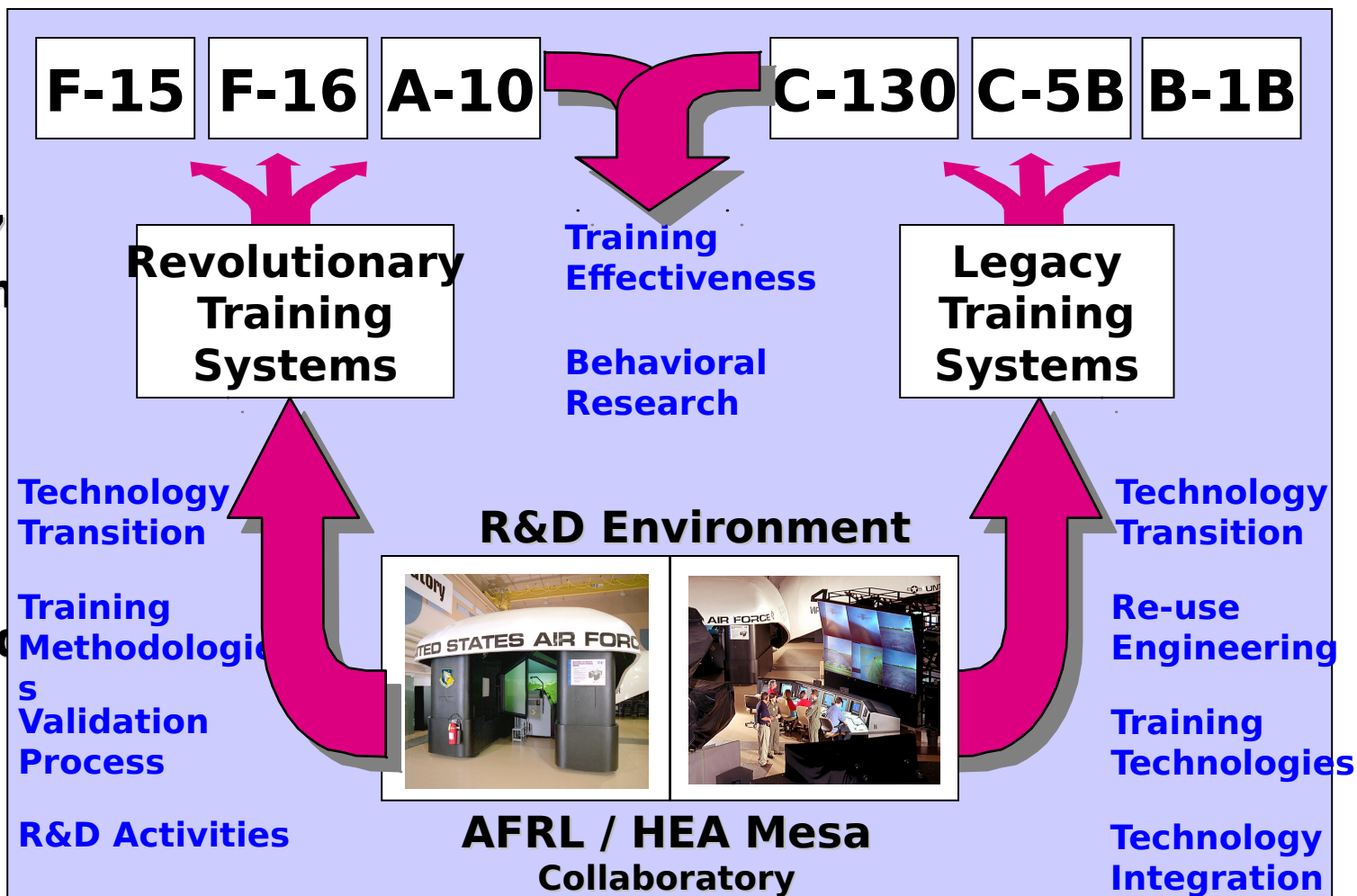
Critical Mass of Intellectual Expertise



Testbed as an S&T Engine

Regional
Component's
DMT System

AFRL/Mesa
DMT Testbed



Provide DMT technology transition to all AEF customers



Leveraging Industrial Partners

<u>Company</u>	<u>Contribution</u>
<u>Amount(\$K)</u>	
Paradigm	Databases
53	
Aechelon	Databases
CACI	Eng Support
25	
EDL Displays	Displays
15	
CGCC	Graphics Computers
32	
Barco	Projectors
125	
Lockheed Martin	IG's/Database
3,160	
F S S	IG's



Agreements & Contracts

6 Inter-Agency Agreements

8 On-Site Contractors

6 Off-Site Contractors

9 Phase I SBIRS

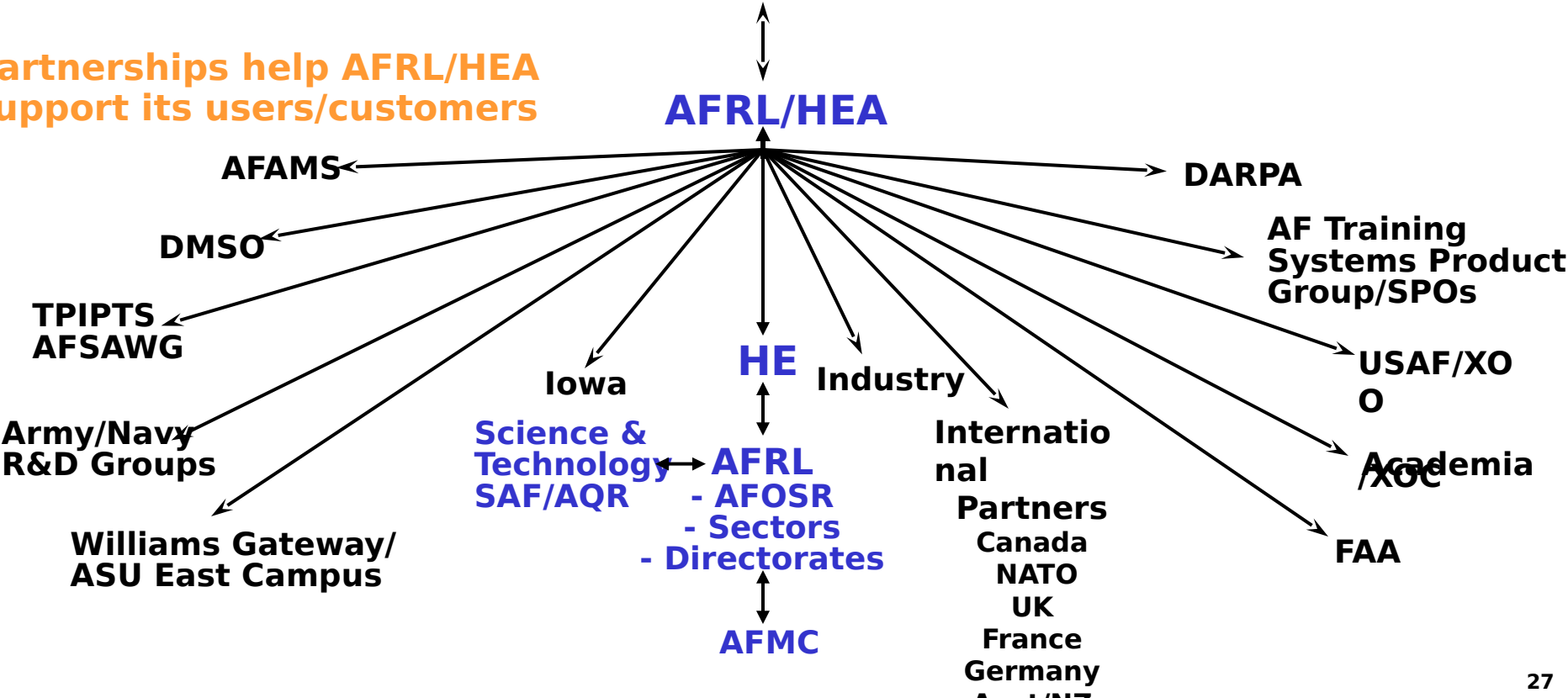
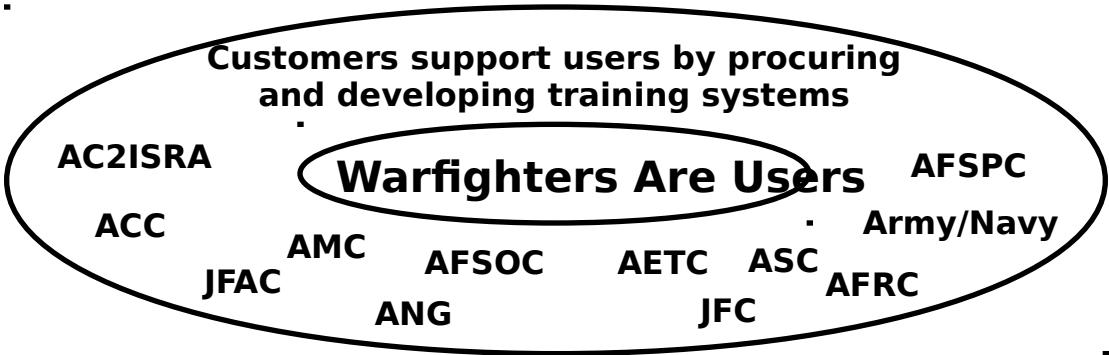
10 Phase II SBIRS



Division Partnerships

Users/Customer

Partnerships help AFRL/HEA support its users/customers





Warfighter Training Thrust



Capability

Provide Agile Combat Support AFT 6

Goal

Advance state of the art in education and training technologies and methods to enable an expeditionary aerospace force

Objectives

- **Develop, validate and transition Distributed Mission Training (DMT) technologies, strategies and methods for flying, space and information operations, command and control , and force protection**
- **Produce Night Vision Training System which will reduce night vision flying accidents by 25% over five years**
- **Increase Command and Control training effectiveness by 50% over the next ten years**
- **Provide training technologies and methods for UCAV platforms, and define operator selection criteria**





DMT Training Environment

Live - Virtual - Constructive Entities



Mission: Provide *combat and combat support* forces a realistic environment, capable of supporting the entire spectrum from individual training up to campaign-level mission r



Sub-Thrusts

- **Knowledge Representation Technology**

R&D to develop, integrate, demonstrate, validate and transition distributed C2 training and performance improvement technologies through an open, collaborative research and development environment supported by DoD, industry and academia.

- **Distributed Mission Training**

R&D of a shared, scaleable training environment comprised of live, virtual, and constructive entities that allows warfighters to affordably train in a realistic, fully integrated environment, capable of supporting the entire training spectrum from individual training Through campaign-level mission rehearsal.

- **Night Vision Device Training**

A Defense Technology Objective (DTO) with USN/USMC sister service participation exploring all areas pertinent to providing sensor-aided night fighting capability.

- **Warfighter Operations Center Training**

Empirically and analytically based research examining the best way to train personnel who man and operate command and control nodes such as Air, Wing and Squadron Operations Centers, producing practical prototypes for Operations Center Training.



Supported Air Force Tasks (AFTs)





Accomplishments

Air Force DMT Integrated Process Team (IPT)

AFRL/CC is a member of Senior Steering Group

Col Straw is a member of O-6 DMT IPT

AFRL/HEA Co-chair Technology & Innovation Working Group

AIR FORCE COUNCIL

AIR FORCE BOARD

NEIP
SAR
Battlelab
Outsourcing & Privatization
Personnel & Training
CI
Installation Support
Logistics
RDT&E
Space Superiority
Information Dominance
Global Mobility
Air Superiority
Power Projection
PANEL

**Air Staff
MAJCOMS
AC2ISRC
Battle Labs**

Defining User Requirements

IPT

Working Groups

**OPFOR
AIA
Mr Cicero**

**Ops & Tng
ACC / DOT
Maj Good
Capt Barbier**

**Architecture
Mgmt
AFCIC
Capt Barbier**

**Tech & Innovation
AFRL/HEA
Maj Good (chair)
Capt Barbier
Mr Cicero**

**Acq & Resources
ASC / YWI
Maj Good**

**Security
TBD
Maj Good
Capt Barbier
TSgt Lambert**



Accomplishments



Distributed Mission Training



- **Warfighter Acceptance of DMT**
 - ACC CTSS
 - Flight-Lead Upgrade Training
- **AFA Convention**
- **NVTS Transition to Marines AV-8**
- **Cockpit Lighting Systems**
 - Deployed for Kosovo
- **MLM Interim Certification**
- **DMSO Sponsored Advances in HLA Real-Time High Fidelity Simulation**
- **AN/ALR-69 RWR Simulation**
 - True bit-wise compatible



Recent Awards for DMT S&T Program



1998 Aviation Week & Space Technology

1999

**Red River Valley (Vietnam)
Fighter Pilot's Association
Award for Outstanding
Contribution**

to the Warfighter

**Training Systems Product
Group Team Performance
Excellence Award for Air
Force Association 50th**

Anniversary Demonstration
Memo to SAF/AQ (AFA 1999):

"My hope is the Air Force will support Colonel Jerry Straw's AFRL team. They are the most creative training developers in the business."

**Institute for Def Analysis/Sim
Center** **Neale Cosby**



Future Opportunities

- **Expanding DMT to space, information, command and control, force protection and ultimately other support areas**
- **Growing International Involvement**
 - **NATO Canada Australia New Zealand France Germany United Kingdom**



Presentation Topics

Representative of Thrust Elements

Knowledge Representation Technology

- Training Research for Automated Instruction
- Distributed Information Environment for C2 Training & Operational Readiness

Distributed Mission Training

- Control System Development
- Cueing (Sensation, Perception, Deliberation, Action, Interaction)
- Event Management
- Performance Feedback/Measurement
- Training Strategies/Methods Evaluation
- Training Strategies/Methods Research

• C4ISR Systems

- Image Processing (C2, Real Time Data Fusion)
- Real Time Intelligence Data Fusion
- Data Links
- High Level Architecture (HLA)
- Multilevel Security (MLS)
- Networks
- Image Generators (IGs)
- Visual Displays
- Computer Generated Forces
- Correlated Multi-Spectral Data Bases
- Semi-Automated Forces
- Synthetic Environments
- Weapons Effects Modeling
- Threat systems
- Crew Resource Management
- Space Training

Programs Covered by Briefing
Programs Covered by Poster



Presentation Topics

Representative of Thrust Elements

Night Vision Device Training

- **Perceptual Effects & Training**
- **Courseware Development**
- **Sensor Simulation**
- **Night Ops Human System Integration**
- **Image Generators for Night Vision Devices**
- **Correlated Multi-Spectral Data Bases**

Warfighter Operations Center Training

- **Warfighter Operations Center - Training and Performance Support**
- **Event Management**
- **Performance Feedback/Measurement**
- **Training Strategies/Methods Evaluation**
- **Training Strategies/Methods Research**
- **C4ISR Systems**
- **Multilevel Security (MLS)**
- **Network**
- **Visual Displays**

Programs Covered by Briefing
Programs Covered by Poster



Central Theme of Thrust

**Provide World's Best Training
Ensuring Warfighters Have the
Skills Needed to Meet
Readiness Requirements**

Make AF Warfighter Training:

- More Effective**
- More Efficient**
- Integrated across the DoD
and with allies**
- The peacetime equivalent
of war**



Summary

Readiness Depends on TRAINING

- **AF Invests Over \$10B / yr. for Warfighter Training**
 - **DMT Technologies and Methods Provide Significant ROI**
- **DMT Concept Accepted Across AF Domains**
 - **Significant Technical Issues Remain**
- **Workforce highly experienced in basic and applied training research has significantly impacted aircrew training--must now apply that experience information operations, space and force protection**
- **Collaboratory strategy allows leveraging across military, industry and academia**



Training for Warfighting Thrust Briefing to SAB

*Final
Questions*



Interagency Agreements

- **MOA with ANG AFRES TEST CENTER - R&D for Tactical Aircrew Training**
- **MOA with NAVTRASYSCEN, USARI, NASA, and the FAA - Aircrew Coordination, Human Factors Research and Training**
- **MOA with ACC and AFRES - Operating Location at Luke AFB, AZ**
- **MOA with NAWCTSD - Low-Cost, Helmet-Mounted Displays for Night Vision Goggles**
- **CONOPS with ASC/YW - Training Systems Product Group Working Relationship**



Contracts (Mesa)

- **On-Site Contractors**
 - **Warfighter Training Research (Raytheon, Boeing, Lockheed-Martin)**
 - **Technical Research Support Services (Operational Technologies)**
- **Off-Site Contractors**
 - **Information Technology Needs Assessment (IJOA) San Antonio, TX**
 - **Microlaser R&D (Evans & Sutherland)**
 - **Networked Training Center (Lockheed-Martin) Luke AFB**
 - **Advanced Instructional Training Strategies (Tuskegee University, HBCU)**



Contracts (Brooks)

- **On-Site Contractors**

- **Training Research for Automated Instruction (TRAIN) - Galaxy Scientific, Inc.**
- **Cognitive Process Modeling - Affiliated Computer Systems (ACS)**
- **Instructional Technologies for Intelligent Training Systems - Global Information Systems**
- **Computer Data Systems - Metrica, Inc.**
- **Intelligent Training Development Support - Command Technology, Inc.**
- **Team Communications/AWACS Human Interfaces - Veridian Inc.**

- **Off-Site Contractors**

- **Simulators in Intelligent Environments - University of Southern California**
- **Intelligent Instructional Design Methodology and Distance Learning - Mei Technologies**



HEA Phase I SBIRs (9)

- **Training for Space Operations Using a Distributed Training Environment - Sytronics, Inc**
- **Collimating Display Screen for Simulator Displays - Physical Optics Corp.**
- **An Intelligent Training Management System (ITMS) - Stottler-Henke Assoc**
- **Preparing the U.S. Air Force for Operations Other Than War - Klein Associates, Inc.**
- **Tools/ Asss Hum Warfighter Perf Readiness & Dist Joint AC Tng Eff - Micro Analysis & Design**



HEA Phase I SBIRs

- **Streamlined, Scenario-Based Meth for Eval Distributed Team Perf - Aptima Inc**
- **Modeling and Simulation of Less Than War Scenarios - McDonald Research Associates**
- **Training for Space Operations Using a Distributed Training Environment - 21st Century Systems, Inc**
- **SNOWCAT: Scenario knowledge Capture for Cog Analysis-based Tng - Modus Operandi Inc**



HEA Phase II SBIRs (10)

- **Full Color Helmet Mounted Display - Laser Power Corp**
- **Decision Support System to Enhance Performance in Decision Making Teams - 21st Century Systems, Inc**
- **System to Enhance Team Decision Making Performance - Aptima, Inc**
- **Full Color, High Definition Head Mounted Display for Pilot Training - MicroVision, Inc**
- **Elec-Assisted Ground Based Learning Environment (EAGLE) - CHI Systems**



HEA Phase II SBIRs

- **Automated Player Control Station - Distributed Simulation Tech, Inc**
- **Intelligent Data Mining Agent for Rapid and Optimal Deployment of Warfighting Knowledge - Knowledge Analysis Tech/Usability Inc**
- **Continued Development of an Instructor's Associate for Rating Aircrew Skills - InterScience America**
- **Internet-based Distributed Team Performance Assessment Technology - Research & Dev Corp**
- **Architecture and Infrastructure/Framework of Java Tools for Adaptive, Collaborative, Distributed Web-based Training - PLS International**